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CASE REPORT

First Ever Robotic Stage One ALPPS Procedure in India: for Colorectal Liver Metastases

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Abstract

Twenty five percent of total liver volume (TLV) is considered as the ideal functional liver remnant (FLR) in major liver resections. In patients with macro-vesicular steatosis, early cirrhosis, and post-neoadjuvant chemotherapy (NACT), hepatocellular injury is common. In such instances, up to 40% of FLR may be required. So in cases of marginal FLR, pre-operative portal vein (PV) embolization or two-stage hepatectomy with PV occlusion is used. Both of which take up to 14 weeks between stages and 30% of patients fail to reach the second resection either due to inadequate FLR growth or disease progression. Associated liver partition and portal vein ligation (ALPPS) procedure has become the gold standard for those cases. A 57-year-old male presented with rectosigmoid growth + multiple right liver and segment 4B metastases. Post-NACT MRI showed interval progression of lesions. Preoperative CT (computed tomography) volumetric scan showed a FLR/TLV (future liver remnant/total liver volume) of 22%. Since patient received 10 cycles of NACT, ALPPS procedure was planned ahead of direct liver resection. Robotic ALPPS stage 1 sparing left lateral segment and 4A + anterior resection was done. We transected the parenchyma between the FLR and the diseased part of the liver with concomitant right portal vein ligation done robotically. CT abdomen done on POD7 showed hypertrophied left lateral segment. Second stage was performed on the eighth post-operative day with FLR/TLV increasing to 37%. Robotic ALPPS procedure for stage one is a safe and feasible technique in experienced centers with advanced robotic skills.

Keywords Colorectal liver metastasis · Robotic ALPPS · FLR hypertrophy · Minimal access

Introduction

Twenty five percent of total liver volume (TLV) is considered as the ideal functional liver remnant (FLR) in major liver resections. In patients with macro-vesicular steatosis, early cirrhosis, and post-neoadjuvant chemotherapy (NACT), hepatocellular injury is common. In such instances, up to 40% of FLR may be required [1]. If a marginal FLR is expected, pre-operative portal vein embolization (PVE) or two-stage hepatectomy in the form of associating liver partition with portal vein ligation for staged hepatectomy (ALPPS) is considered to increase the FLR. Pre-operative PVE can take up to 14 weeks between stages and 30% of patients fail to reach the second resection either due to inadequate FLR growth or disease progression [2]. ALPPS is hence considered a novel approach and gaining considerable interest. So far, less than ten totally robotic ALPPS procedures have been described in the literature [3].

History

A 57-year-old male patient was diagnosed with adenocarcinoma of the rectosigmoid with simultaneous liver metastases (multiple right lobe liver lesions with segment 4B lesion). Patient received ten cycles of NACT prior to visit to our Center. Post-NACT radiological imaging showed progression in size of liver lesions and rectosigmoid growth. Patient was planned for simultaneous anterior resection and liver metastatectomy.

Right lobectomy and segment 4B resection was planned based on the location of lesions. As the FLR was 22%

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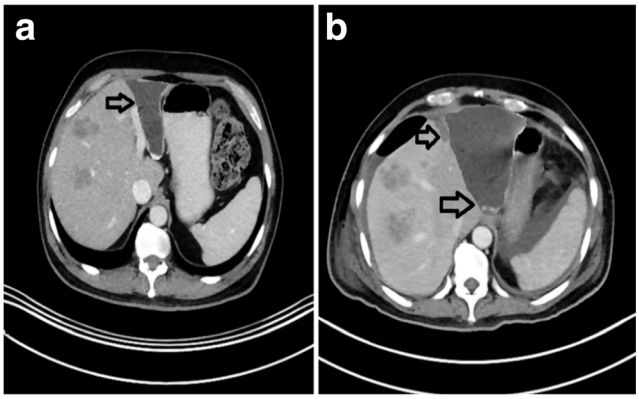

Fig. 1 Pre-operative (**a**) and post-operative CT (**b**) picture showing hypertrophy of the left lobe of the liver next to the line of transection (short arrow)

(Fig. 1), ALPPS procedure was planned and an option of robotic procedure was given.

Technique and Results

Robotic ALPPS stage 1 sparing left lateral segment and 4A + anterior resection was performed. Port placements were different for the anterior resection and ALPPS procedure. (Fig. 2).

Anterior Resection

Ports 1–4 were placed beginning from supra-umbilical camera port. Inferior mesenteric artery was ligated and divided and the mesocolon and the rectum with adequate margin were mobilized. The rectosigmoid was resected using endostaplers and anastomosis was completed.

ALPPS Stage 1

Port 4 was used as an assistant port. The fifth port was placed infra-umbilical in midline for camera. The sixth port was placed in the left hypochondrium. The seventh port was placed in the right lumbar region. Ports 1 and 2 were not used. Cholecystectomy was performed; right portal vein was doubly ligated (Fig. 2). The line of liver transection was between left lateral segments and segment 4B and then it was taken across ending up between segment 4A and segment 8. Gall bladder and rectosigmoid growth were removed using a small Pfannenstiel incision.

Patient did not require any blood/blood products transfusion with blood loss of around 100 cm^3. CECT abdomen done on POD7 showed marked hypertrophy of the remnant left liver. Second stage was performed on the eighth post-operative day with a FLR/TLV of 37% by open approach (Fig. 2). Post-operative pathology of the liver and rectal tumor showed margins free from disease. The post-operative period was uneventful. His LFT were within normal limits with total bilirubin being < 0.5 mg/dl except mild elevation of SGOT/SGPT. He was ambulated and shifted out of ICU on POD1. Follow-up was 17 months since the ALPPS surgery. He had recurrence of lesions in the liver recently on follow-up. We have done microwave ablation of the recurrent tumors.

Discussion

Recent studies have noted the marked hypertrophy of the FLR, which enlarges by 40–80% within 6–9 days. Faster hepatocyte regeneration has resulted in a lower drop-out rate for the two-stage procedure. This waiting time can be critical, especially for patients with marginally resectable tumors or oncologically aggressive tumors [4].

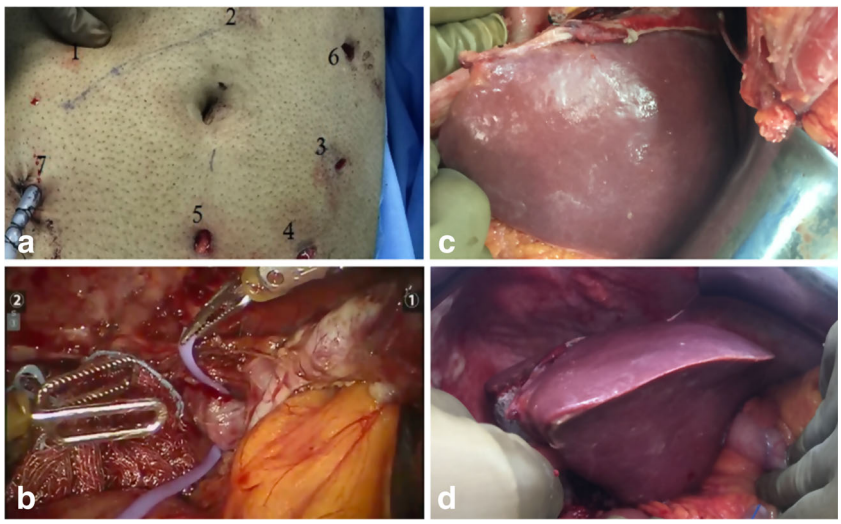

Fig. 2 **a** Port placements. **b** Robotic looping of the right portal vein. **c**, **d** Hypertrophied left lobe post-stage two

The secret being faster hepatocyte regeneration in ALPPS compared to the conventional PVE and have resulted in lower drop-out rates. PVE can take up to 3–4 weeks for the sufficient increase in FLR, this waiting period being very critical for patients with marginally resectable tumors or oncologically aggressive tumors resulting in disease progression [2]. Post-hepatectomy liver failure could be more common after major resection due to low FLR or post-NACT liver injury. ALPPS offers a new ray of hope for all those patients [5, 6].

Major advantages of robotic surgery are endo-wristed movements, software filtration of the surgeon's movements, and high-definition 3-D vision provided by the stereoscopic camera. This allows steady and careful dissection of the structures of the liver hilum as well as prompt and precise endo-suturing in cases of intraoperative bleeding. Like laparoscopy, even robotic approach minimizes blood loss and reduces the risk of a required transfusion as shown in our case [7]. This is really a great result for patient and us considering poor outcomes for colorectal malignancy with bilobar liver metastases.

Drawback

It can be considered now historic, major drawback of robotic surgery is high operational cost and longer operative time [8].

Conclusion

Cases such as this prove that robots have their place in future and here to stay. As more and more surgeons start doing robotic resections, the docking and operative time could be minimized without compromising on safety. ALPPS procedure performed by robotic approach could be a safe and feasible technique in experienced centers with good robotic skills. Patient's recovery after stage one is faster with lesser post-operative pain, early ambulation, less post-operative complications, and, most importantly, FLR hypertrophy as good as open technique. So by stating all the above advantages, we state the use of robotics in ALPPS procedure could be the standard of care in future in selected patients.

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